Method for processing gunned concrete by means of a spraying machine, and spraying machine

Technical field

The invention starts out from a method of processing gunned concrete by means of a spraying machine according to the preamble of the first claim. The invention likewise starts out from a spraying machine according to the preamble of the independent apparatus claim.

Prior art

Concrete-gunned concrete processes and the spraying machines used for this purpose, e.g. Sika® Aliva® spraying machines, are generally known. A distinction is made essentially between dry spraying processes and wet spraying processes.

In the wet spraying process, the hydraulic binder, for example cement, lime or gypsum plaster, appropriate aggregates such as gravel and sand, if necessary, concrete additives are mixed with water before spraying. The wet concrete to be sprayed is then conveyed hydraulically in the dense stream process or pneumatically in the thin stream process to the spray nozzle. In the dense stream process, the dense stream is broken up shortly before the spray nozzle by means of a high air pressure and, if necessary, accelerators are introduced by means of the air stream. In the thin stream process, the accelerator is likewise introduced

by means of air into the concrete to be sprayed shortly before the spray nozzle.

In the dry spraying process, the dry concrete to be sprayed comprising hydraulic binder, aggregates and, if necessary, concrete additives is introduced into the concrete spraying machine. It is in this case conveyed pneumatically in the thin stream process. Water admixed with accelerator is introduced shortly before the spray nozzle.

The concrete additives, in particular accelerators, which are added in the region of the spray nozzle are always introduced in liquid form. These liquid additives, in particular setting accelerators, are usually brought in containers to the spraying apparatus or to the spraying machine. However, a problem with these liquid additives is the storage stability which is frequently unsatisfactory, as a result of which the additives can become unusable on prolonged storage. In addition, these liquid concrete additives have a relatively large volume, which is why the feeding to the spraying machine can present transport and feeding problems.

To overcome the stability problems, additives, in particular setting accelerators, have for this reason been transported in powder form to the building site and there dissolved in water on site. The liquid setting accelerators obtained in this way have then been transported from the building site to the spraying apparatus and used in a manner analogous to the already liquid setting accelerators for spraying of the gunned concrete. However, this requires an additional step and the processing of the pulverulent accelerator places severe demands on personnel and leads to severe dust pollution. After dissolution of the pulverulent additive, the liquid accelerator obtained likewise has to be processed relatively quickly since stability problems can also occur here.

Description of the invention

It is an object of the invention, in a method of processing gunned concrete by means of a spraying machine and a spraying machine of the type mentioned at the outset, to be able to process additives simply and without stability problems in the spraying of the concrete.

According to the invention, this is achieved by the features of the first claim.

The key aspect of the invention is thus that at least one additive which has a proportion of solids is mixed with water in a mixing apparatus and is fed from the mixing apparatus into the concrete to be sprayed before it leaves the spray nozzle.

The advantages of the invention are, inter alia, that in the concrete spraying process according to the invention, the concrete additive or additives which have a particular solids content and are, in particular, pulverulent are brought directly to the spraying machine, and in each case only the required amounts of additive are directly mixed with the appropriate amount of water there. This method incurs lower transport costs because of the lower mass to be transported and the storage stability of the dissolved additives is no longer important. Due to this reduction in the stability requirements, the additives to be used can be improved chemically since the stability of the components in the liquid state now plays only a very minor role.
Furthermore, the amount of additive in the liquid additive mixture fed to the concrete to be sprayed can be adjusted very simply and thus allows the properties of the sprayed gunned concrete to be matched to specific requirements. In addition, the liquid additive mixture produced can have a higher concentration of

active ingredients than conventional liquid additives, as a result of which the properties of the concrete produced can be improved.

It is likewise advantageous that additives which have hitherto not been able to be used because of their stability-reducing action can be introduced into the concrete to be sprayed by means of the present method.

The adjustability of the viscosity of the liquid additive mixture in the mixing apparatus enables the viscosity to be set so that the additive is distributed as well as possible in the gunned concrete.

Further advantageous embodiments of the invention are indicated in the subordinate claims.

Brief description of the drawing

Examples of the invention are described below with the aid of the drawings. Identical elements are denoted by the same reference numerals in the various figures. The flow direction of the media is indicated by arrows.

In the figures:

fig. 1 schematically shows a spraying machine;
fig. 2 schematically shows a mixing apparatus according to the invention;
fig. 3 schematically shows a further mixing apparatus according to the invention.

Only the elements essential for a direct understanding of the invention are shown.

Way of performing the invention

Fig. 1 shows, schematically and in greatly simplified form, a spraying machine 1. Such a machine comprises a water and compressed air feed line 2, wheels 3 with a wagon, a feed hopper 4 for introduction of the concrete

to be sprayed, a hose 5 and a spray nozzle 6 connected to the hose. The hose 5 can also consist of tubes but has to be flexible at least in the region of the spray nozzle 6 so that the gunned concrete can be applied. In addition, the spraying machine 1 is provided with a further line 7 which opens into the hose in the region of the spray nozzle 6. In the wet spraying process, air admixed with additives is introduced via the line 7, and in the dry spraying process water admixed with additives is introduced via the line 7.
The spraying machine 1 is additionally provided with a mixing apparatus 8 for additives, which can be integrated directly into the machine 1 or else can be connected to the machine by means of lines which are not shown.

Fig. 2 schematically shows the mixing apparatus 8 and the associated parts of the spraying machine 1. The mixing apparatus comprises essentially a reservoir 10, a water feed line 9 and a mixer 11. Concrete additive 12, advantageously an accelerator, is introduced in powder or granule form into the reservoir 10. Such additives, e.g. setting accelerators, corrosion inhibitors, fluidizers, etc., are generally known. Accelerators are particularly important for the spraying of concrete; these are marketed by Sika®, e.g. under the name Sigunit®.

The container 10 is advantageously provided with a tightly closing lid so that no atmospheric moisture can get to the additive 12. A metering device 13, for example a slider, or a metering screw, star feeder, etc., performs the function of metering the pulverulent additive 12 into the mixer 11. If the container 1 with the pulverulent additive 12 is located on a weighing device 14, the use of a slider is sufficient for metering. If a metering screw is used as metering device, a weighing device 14 is not necessary.

Water is metered via the water feed line 9 by means of a metering valve 15 into the mixer 11. The water can also be temporarily stored in a container which is not shown and there brought to a particular processing temperature. Impeller mixers, dispersers or rotor-stator mixers, for example, are used for the mixing of water and pulverulent additive in the mixer 11. The resulting liquid additive mixture can be a solution, a dispersion or a combination of a solution and a dispersion. This is in each case dependent on the solubility of the additive used. Dispersions comprising relatively insoluble additives should advantageously have a certain stability so that they do not sediment in the case of any interruption to the spraying process. Complete solutions are not absolutely necessary since additives which are sparingly soluble in water can also lead to good results in the gunned concrete.

Any amounts of additive can in principle be added to the water in the mixer. The proportion of pulverulent additive 12 in the water is usually from 5 to 95% by weight, preferably from 40 to 80% by weight, particularly preferably from 40 to 60% by weight.

The liquid additive mixture obtained in this way can be pumped by means of the mixing tools located in the mixer 11 out of the mixer 11 through a circulation line 16 and back into the mixer 11, which improves mixing. It is also possible for a pump to be located in the circulation line, as a result of which it may no longer be necessary to use mixing tools in the mixer. One or more heating devices which are not shown can optionally be located either in the water feed line 9, in the temporary water storage which is not shown, in the mixer 11 and/or in the line 16, by means of which the liquid additive mixture or the water fed in is heated to relatively high temperatures, in particular to a temperature above 40°C, in order to improve the

solubility of the powder and to influence the viscosity of the liquid additive mixture.

The liquid additive mixture is then fed by means of a feed line 17, which branches off directly from the mixer 11 or the circulation line 16, to the line 7 which conveys, depending on the spraying process, water or air to the spray nozzle. The feed line 17 can for this purpose be provided with a metering valve or a metering pump 18 by means of which the amount of liquid additive mixture to be introduced into the concrete to be sprayed can be set. From about 2 to 15% by weight of the liquid additive mixture is introduced into the concrete to be sprayed, based on 100% by weight of the hydraulic binder in the concrete. The addition of the liquid additive mixture is thus controlled by the throughput of the concrete being sprayed and the proportion of hydraulic binder present therein.

The mixing apparatus is operated by means of a computer control system which is not shown. The determination of the respective amounts of water, pulverulent additive 12 and hydraulic binder introduced can be effected by means of separate measuring instruments/ meters or directly by means of the metering device 13, the weighing device 14, the metering valve 15, the metering valve 18 or via the amount of concrete or hydraulic binder fed in.
For example, the desired mixing ratio can be set via the amount of additive 12 and water fed to the mixer 11. If a particular amount of liquid additive mixture is taken from the mixer by means of the metering valve 18, the amount taken off can be determined by the regulation by means of the opening time of the metering valve 18 or by a measuring instrument which is not shown. To replace the amount taken off in the mixer, the required amounts of additive 12 and water are fed via the metering device 13 and the metering valve 15 into the mixer 11.

The storage volume of the mixer 11 also leaves the operating personnel some time to refill the container 10 if the additive has been used up or in the case of disruptions to the water flow through the water feed line, to rectify these.

The present method also enables the content of the pulverulent additive 12 in the water to be set to any desired value within the abovementioned limits. Thus, it is possible to react quickly to a changing content of hydraulic binder or the concrete to be sprayed.

In the present method according to the invention, no large amounts of the liquid additive mixture are prepared beforehand, with the volume of the mixer 11 usually being in the range from 1 to 80 liters. Due to the small amounts and due to the fact that in each case only the necessary amounts of additive are liquefied, no problems with the stability of the liquid additive occur in the present method. Furthermore, the volume of the pulverulent additive is at least a factor of two smaller than when liquid additives are used, as a result of which lower transport costs are incurred and environmental pollution is reduced and the spraying machine can have smaller dimensions.

In fig. 3, the mixer 11 and the circulation line 16 of fig. 2 are replaced by a permanent mixer 19, e.g. an extruder. Such an extruder has at least one mixing and transport screw. As permanent mixer, it is also possible to use, for example, only a mixing rod with mixing elements which is arranged in an essentially horizontal hollow cylinder. In the permanent mixer, the additive introduced via the metering device 13 and the water introduced via the water feed line 9 are mixed and a solution and/or a dispersion are/is formed in a manner analogous to that described above.
Here, the use of the metering pump 18 is not necessary since the extruder 19 takes over the transport and the

metering of the liquid additive mixture. Since very good mixing is achieved by means of the extruder 19, a circulation line is not necessary. The extruder 19 can be heatable in order to improve the solubility of the powder and to influence the viscosity of the liquid additive mixture.

Of course, the invention is not restricted to the example shown and described. The mixer or the extruder can also be replaced by components having an identical or similar action.

It is also possible to use a thickened additive or moist powder instead of the pulverulent additive; this is brought to the appropriate mixed contents with water in the mixing apparatus. However, attention may have to be paid to stability problems here. The additive to be used for the purposes of the invention should have a certain solids content of at least 1%, preferably above 10%, particularly preferably above 50%, in particular above 80%.

The use of a plurality of mixing apparatuses also enables additives which are inherently incompatible or slightly moist or liquid additives as mentioned above, in particular ones which do not suffer from stability problems, and pulverulent additives to be processed separately in the various mixing apparatuses and introduced into the concrete to be sprayed. When a plurality of mixing apparatuses is used, these can be arranged in parallel and the liquid additive mixtures can be introduced separately or via a joint line into the concrete to be sprayed. To obtained better mixing, the mixer 11 and permanent mixer 19 can also be combined in one mixing apparatus and connected in parallel or in series.

List of reference numerals

1 Spraying machine

2 Compressed air feed line

3 Wheel
4 Feed hopper
5 Hose
6 Spray nozzle
7 Line for water or air
8 Mixing apparatus
9 Water feed line
10 Reservoir
11 Mixer
12 Concrete additive
13 Metering device
14 Weighing device
15 Metering valve
16 Circulation line
17 Feed line
18 Metering valve or metering pump
19 Permanent mixer